

REMARKS

Status of the Claims

Claims 1, 3, 5-7, 9 and 11-12 are pending in the present application. Claims 1, 3, 9 and 12 have been amended. Support for the recitations of claim 1 can be found in the present specification. Specifically, the present specification discloses, "The reaction can be carried out under normal pressure (atmospheric pressure) or under a pressure (under a load). The reaction pressure is, for example, normal pressure (0.1 MPa) to about 10 MPa, and preferably **about 1 MPa to about 8 MPa**, but it may be higher than this range" (page 47, lines 13-17; emphasis added). In the present invention, the oxygen-containing gas contains oxygen in amount of 10% to 50% so that the reaction is carried out under a pressure of oxygen of 0.1 (1×10%) **MPa** to 4 (8×50%) **MPa**. Claims 3, 9, and 12 were amended to change dependency. No new matter has been added by way of the above amendments.

Applicants submit that the present Amendment is merely formal in nature, is in accordance with the Examiner's instructions, reduces the number of issues under consideration, and places the case in condition for allowance. Entry of the present amendment is proper to place the claims in better form for appeal.

Applicants respectfully request the Examiner to reconsider and withdraw the rejections in view of the following remarks.

Claim Objections

The Examiner has objected to claim 3 for referring to cancelled claim 2. Applicants have removed the reference to claim 2. As such, Applicants respectfully request that this objection be removed.

The Examiner also notes that the new claims previously presented (claims 10-11) should be numbered as claims 11 and 12. Applicants have corrected this issue. As such, Applicants respectfully request that this objection be removed.

Issues under 35 U.S.C. § 103

The Examiner has rejected claims 1-7, 9 and 11-12 under 35 U.S.C. § 103(a) as being unpatentable over Ishii et al. '804 (EP 1459804) and Narihisa et al. '618 (JP2003128618) in view of Turner et al. '099 (US 6,307,099). Applicants note that claims 2 and 4 have been previously cancelled.

With respect to the remaining claims, Applicants respectfully traverse, and reconsideration and withdrawal of this rejection are respectfully requested.

Turner et al. '099 teach, "According to a second aspect of the present invention, ... there is provided a process for the production of terephthalic acid by the liquid phase oxidation of a precursor of terephthalic acid with oxygen in a reaction medium containing the precursor and a solvent under conditions such that substantially all of the terephthalic acid produced in the oxidation reaction zone is maintained in solution during the reaction, characterised in that the oxidation reaction is carried out with *substantially all of the oxygen dissolved in the reaction medium*" (column 2, lines 6-15; emphasis added). Turner et al. '099 also teach, "Substantially all of the oxygen utilised in the process according to this aspect of the present invention is dissolved in the reaction medium. *The use of dissolved oxygen* in the reaction medium allows the oxygen to be more uniformly distributed throughout the reaction medium. In this manner, oxygen starved regions within the reaction medium can be minimised with consequential reduction in the formation of undesirable reaction by-products such as trimellitic acid, benzoic acid and colour bodies" (column 2, lines 22-30; emphasis added).

In one scheme shown in Fig. 1A of Turner et al. '099, Turner et al. '099 disclose, "The method of introducing the oxygen into the reaction may vary. In a preferred embodiment of the invention the oxygen or oxygen-containing gas is introduced into the reaction medium in such a way that *substantially all of the oxygen or oxygen-containing gas is dissolved in the reaction medium* so that the reaction can be conducted under single phase conditions with those components which, in a conventional terephthalic acid production process, would otherwise be in the gas phase and solid phase being present in dissolved form in the liquid phase reaction medium" (column 14, lines 38-47; emphasis added).

In this scheme, Turner et al. '099 teach, "***Oxygen in excess of the stoichiometric amount required for the reaction*** is added, via feed D, to the mother liquor feed C which is under system pressure and, if necessary, after addition of the oxygen is preheated, and ***the resulting oxygen-containing liquid***, feed F, is introduced into the inlet region 10A" (column 14, lines 61-66; emphasis added). In addition, Turner et al. '099 teach, "The system operating pressure, i.e. the pressure to which the feeds E and F are pressurised, is selected so that ***all of the oxygen or oxygen-containing gas introduced enters into solution into the liquid phase reaction medium*** while ensuring that boiling of the reaction medium is prevented. ***Where pure oxygen is employed as the oxygen source, the system operating pressure may typically be in excess of about 60 bara*** and will be correspondingly increased ***where a diluent is present. For instance, where the oxygen is supplied in the form of a gas containing 80% oxygen and 20% nitrogen, the system operating pressure will be typically in excess of about 75 bara***" (column 15, lines 12-23; emphasis added).

Turner et al. '099 further teach in the examples that "[t]he system pressure is set to ensure the desired amount of oxygen (***in excess of the stoichiometric paraxylene requirement***) goes into solution" (column 24, lines 25-27; emphasis added).

In the examples of Turner et al. '099, where pure oxygen is employed as the oxygen source, the system operating pressure may typically be in excess of about 60 bara (60 bara = 6 MPa) as mentioned above. Therefore, the amount of oxygen dissolved in the reaction medium in the examples of Turner et al. '099 is approximately calculated as 1.41 (0.0235×60) mmol per 100ml of the reaction medium on the basis of 0.0235mmol of dissolved oxygen per 100ml of water under saturated solubility at 30°C and 1 bara (0.1MPa). The solubility to acetic acid is almost the same as that to water, and the solubility becomes smaller as the temperature becomes higher. Thus, the real amount of the dissolved oxygen in the examples of Turner et al. '099 may, in fact, be smaller than this calculation.

As shown in TABLE 1 of Turner et al. '099, the solvent is 5% water and 95% acetic acid, and 0.5% w/w (200:1 solvent ratio) of paraxylene is used. Therefore, 0.5g (4.7mmol) of p-xylene was used per 100g of the solvent, and 9.4mmol of oxygen for oxidation is required.

In order to set the system pressure to ensure the desired amount of oxygen (in excess of the stoichiometric paraxylene requirement) goes into solution, a system operating pressure in Turner et al. '99 in excess of about 60 bara may be required.

In contrast, with the present invention, oxygen is fed to the reaction system with the oxygen concentration in an offgas being 1% to 8%. The production efficiency of the target compound and the utilization efficiency of the catalyst may often decrease under conditions of an excessively low oxygen concentration in the offgas. On the other hand, safety may often decrease under conditions of an excessively high oxygen concentration in the offgas (page 42, lines 15-20 in the present specification). The amount of oxygen dissolved in the reaction medium under a pressure of 2 MPa (1% to 8% of oxygen concentration) is approximately calculated as 0.005 to 0.038 mmol per 100ml of the reaction medium.

In the present EXAMPLE 1, 0.09wt% of p-xylene, i.e., 0.09g (0.85mmol) of p-xylene per 100g of the solvent was used, and 2.6mmol of oxygen for oxidation is required. While the amount of oxygen dissolved in the solvent is as extremely low as 0.005 to 0.038 mmol per 100ml of the solvent, *unexpected beneficial results* such as 83.4% yield of terephthalic acid with a conversion from p-xylene of 99.1% were obtained.

Accordingly, the method of the present invention completely differs from a process with a plurality of reactors or reactions in sequence taught in Turner et al. '099.

Regarding Ishii et al. '804 and Narihisa et al. '618, as shown in the following table, space-time yields (mol / h · mol-cat) of terephthalic acid, per 1 mole of the catalyst (nitrogen-

containing cyclic compound) and per 1 hour of reaction time, are 2.3 and 11 mol / h • mol-cat, respectively.

On the other hand, in EXAMPLE 1 of the present invention, the space-time yield is extremely higher, 27.8 mol / h • mol-cat, and *unexpected beneficial results* were obtained.

	Space-time yield (mol / h • mol-cat)
EXAMPLE 1 of the present invention	27.8
EXAMPLE 20 of EP'804	2.3
EXAMPLE 1 of JP'618	11

The Examiner states that Ishii et al. '804 teach the possibility of the reaction of a continuous system. However, no example is provided.

Relevant to this § 103(a) rejection, *Graham v. John Deere*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966) has provided the controlling framework for an obviousness analysis, wherein a proper analysis under § 103(a) requires consideration of the four *Graham* factors. One such factor includes the evaluation of any evidence of secondary considerations (e.g., commercial success; unexpected results). 383 U.S. at 17, 148 USPQ at 467. In this regard, Applicants respectfully submit that the present invention has achieved unexpected results, whereby such results rebut any asserted *prima facie* case of obviousness. See *In re Corkill*, 711 F.2d 1496, 226 USPQ 1005 (Fed. Cir. 1985). Also, the comparative showing need not compare the claimed invention with all of the cited prior art, but only with the closest prior art. See MPEP 716.02(b) and 716.02(e).

In this regard, Applicants note MPEP 2144.08(5)(B), which states that rebuttal evidence and arguments can be presented in the specification, *In re Soni*, 54 F.3d 746, 750, 34 USPQ2d 1684, 1687 (Fed. Cir. 1995).

Thus, due to the unexpected results as achieved by the present invention, the rejection has been overcome. Reconsideration and withdrawal of the rejection are respectfully requested.

Further, in EXAMPLE 20 of Ishii et al. '804, a reaction was carried out under the condition of a concentration of the aromatic compound B in the reaction system of **4.0 percent by weight**. In EXAMPLE 1 of Narihisa et al. '618, a reaction was carried out under the condition of a concentration of the aromatic compound B in the reaction system of **10.0 percent by weight**.

On the other hand, important features of the method according to the present invention are *(1) employing a continuous gas-liquid reaction system* (full circulation system) for maintaining the system to a constant condition by continuously feeding the catalytic nitrogen-containing cyclic compound A, the aromatic compound B, a reaction solvent, and oxygen to a reactor and continuously extracting the reaction mixture from the reactor; and *(2) carrying out a reaction under the condition of a concentration of the aromatic compound B in the reaction system of 3.0 percent by weight or less* (page 42, line 22 to page 43, line 6 in the present specification).

If the reaction is carried out at a concentration of the aromatic compound B **exceeding 3.0 percent by weight**, the yield of the target compound **significantly decreases**, and the production of the target compound per a specific amount of the catalyst used **markedly decreases**. *This is probably because the stability of the catalyst decreases* (page 43, lines 12 to 18 in the present specification).

In a batch reaction system [a full batch reaction system or a gas-circulation batch reaction system (a system of continuously feeding gas to the reactor)], when the concentration of the aromatic compound B in the fed liquid is increased, the concentration of the aromatic compound B in the reaction system generally exceeds 3.0 percent by weight in early stages of the reaction, likely due to the reduced stability of the catalyst, and the reaction rate significantly decreases after the reaction proceeds to some extent. As a result, the yield of the target compound decreases, and the production of the target compound per a specific amount of the used catalyst markedly decreases. In contrast, when the concentration of the aromatic compound B in the fed liquid is decreased, the production of the target compound per one batch is small, and the production efficiency markedly decreases in quantity. Consequently, the target aromatic carboxylic acid cannot be efficiently industrially produced using to a batch system (page 44, lines 8 to 25 in the present specification).

Accordingly, the limitations "a concentration of the aromatic compound B in the reaction system of 3.0 percent by weight or less," "a molar ratio of the catalytic nitrogen-containing cyclic compound A to the aromatic compound B in the reaction system of 0.01 or more," "an oxygen concentration in an offgas of 1% to 8% with the oxygen to be fed to the reaction system being an oxygen-containing gas containing oxygen in an amount of 10% to 50%," and "a pressure of oxygen to be fed to the reaction system being 0.1 MPa to 4 MPa" are **not** obvious to one of skill in the art based on routine experimentation and optimization, and the present invention is believed to be patentable over Ishii et al. '804 and Narihisa et al. '618 in view of Turner et al. '099.

To establish a *prima facie* case of obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. (See MPEP 2143.03). As discussed above, the references fail to teach or suggest all the claim limitations of independent claim 1, and those claims dependent thereon. Therefore, a *prima facie* case of obviousness has not been established, and withdrawal of the instant rejection is respectfully requested.

Applicants therefore respectfully submit that all pending claims clearly distinguish over the cited prior art.


In view of the above amendment, Applicants believe the pending application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Chad M. Rink, Reg. No. 58,258 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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